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Aoki

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(54) **CONTROLLING DEVICE**

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(30) **Foreign Application Priority Data**

Jul. 25, 2012 (JP) 2012-164401

(51) **Int. Cl.**

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G01R 33/038	(2006.01)
H01R 13/639	(2006.01)
H01R 13/70	(2006.01)
H01R 9/24	(2006.01)
H01R 13/627	(2006.01)
H01R 13/66	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 13/641*** (2013.01); ***G01R 33/038*** (2013.01); ***H01R 13/639*** (2013.01); ***H01R 13/701*** (2013.01); *H01R 9/24* (2013.01); *H01R 13/6272* (2013.01); *H01R 13/6658* (2013.01)

(58) **Field of Classification Search**

CPC H01R 9/00; H01R 13/625; H01R 13/641

USPC 439/489, 347, 38, 39, 911, 709

See application file for complete search history.

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(57) **ABSTRACT**

A controlling device includes a controlling device main unit, a terminal block removably attached to the controlling device main unit, and a lock mechanism. The terminal block attached to the controlling device main unit is locked through the movement of a slide member provided with the controlling device main unit. The slide member includes a permanent magnet disposed in a specific position. The controlling device main unit includes a magnetism detecting portion that detects magnetism of the permanent magnet, located in a location in proximity to the permanent magnet, disposed in the slide member, in a state wherein terminal block is locked through movement of the slide member, and a lock status confirming portion that confirms whether or not the terminal block is in a locked state, based on a detection signal from the magnetism detecting portion indicating whether or not magnetism is present.

1 Claim, 8 Drawing Sheets

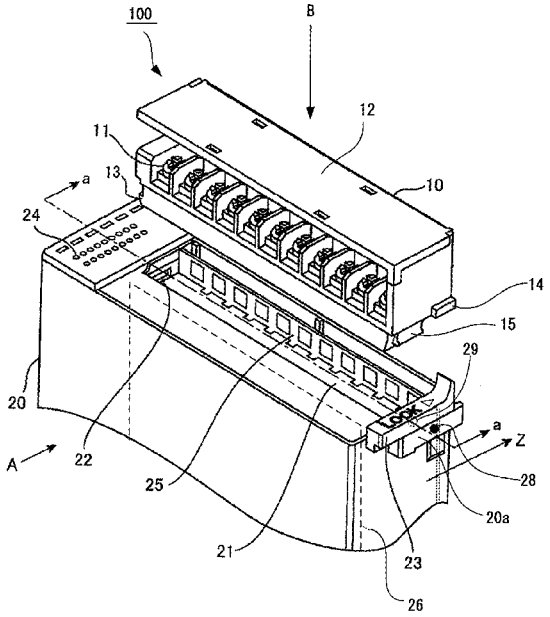
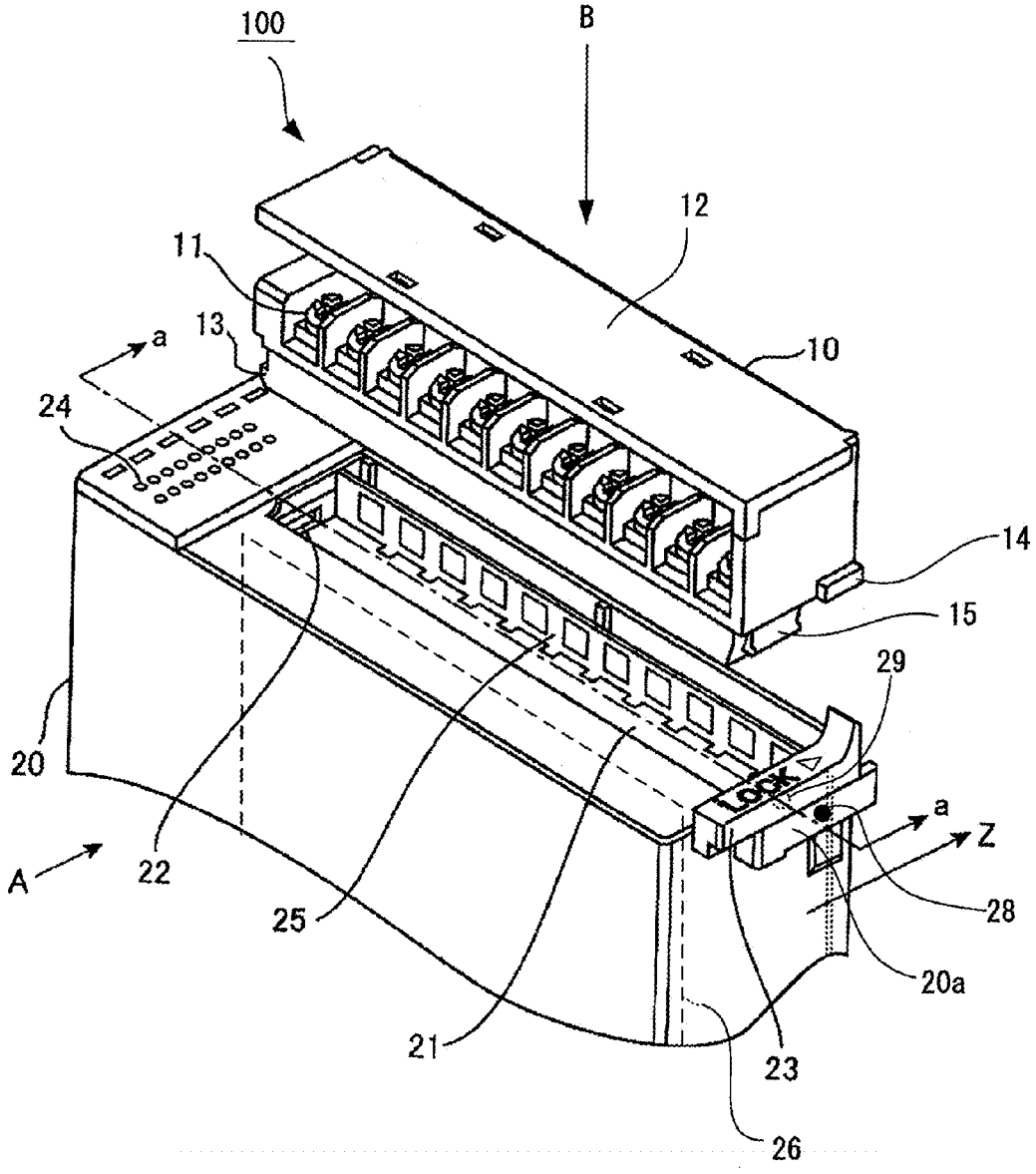
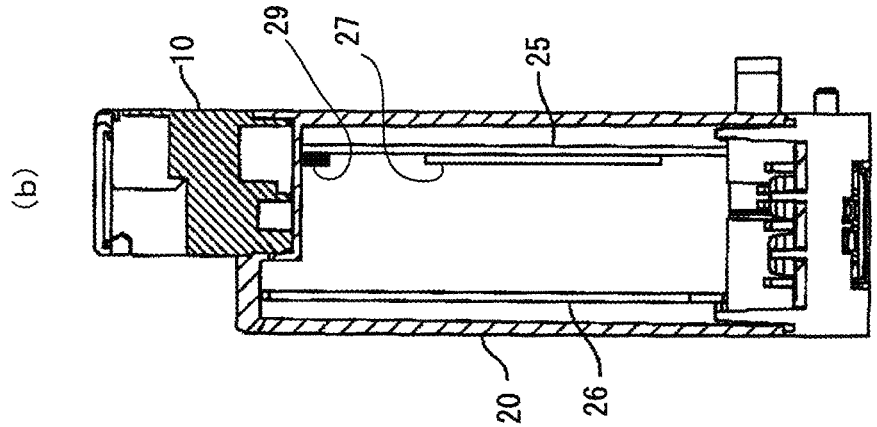


FIG. 1





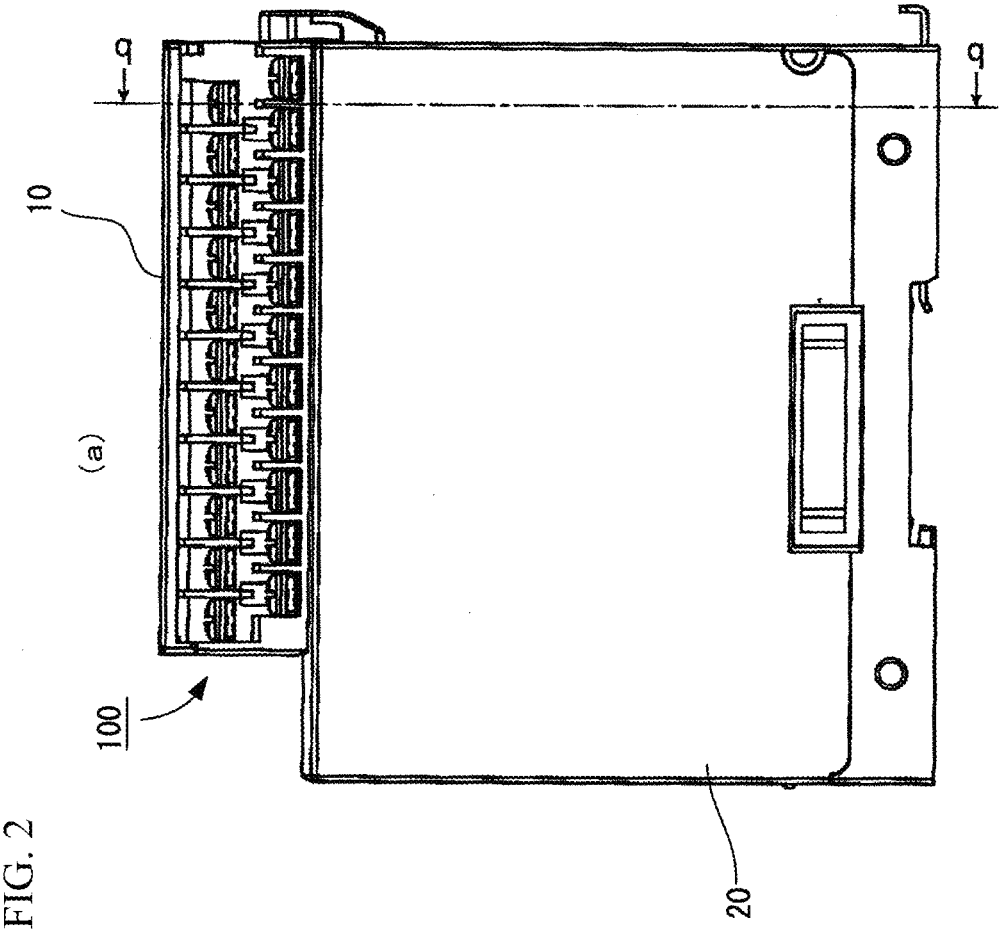


FIG. 2

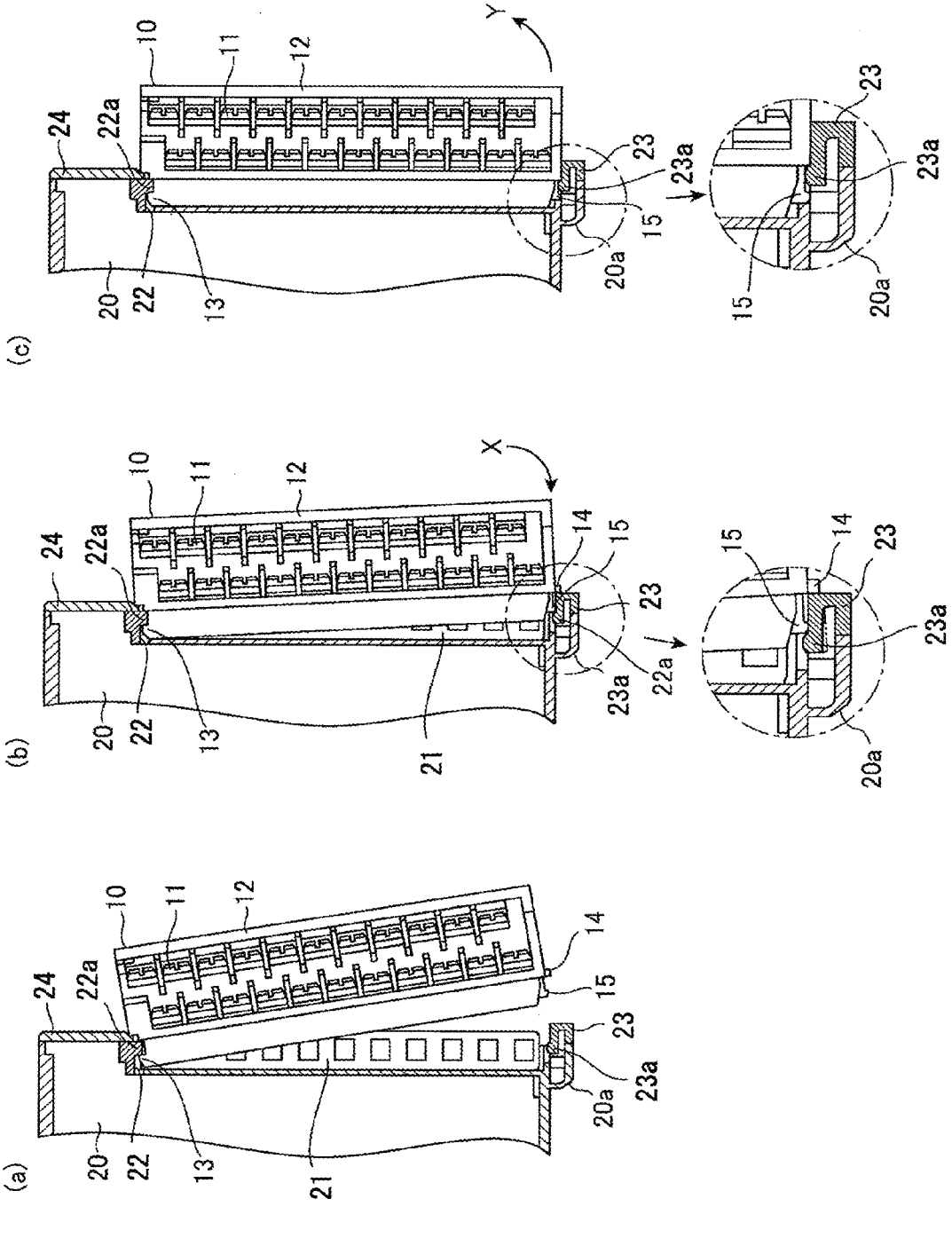


FIG. 3

FIG. 4

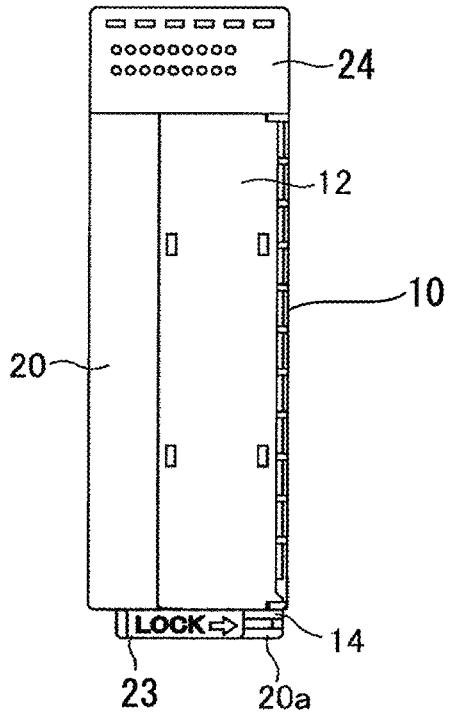


FIG. 5

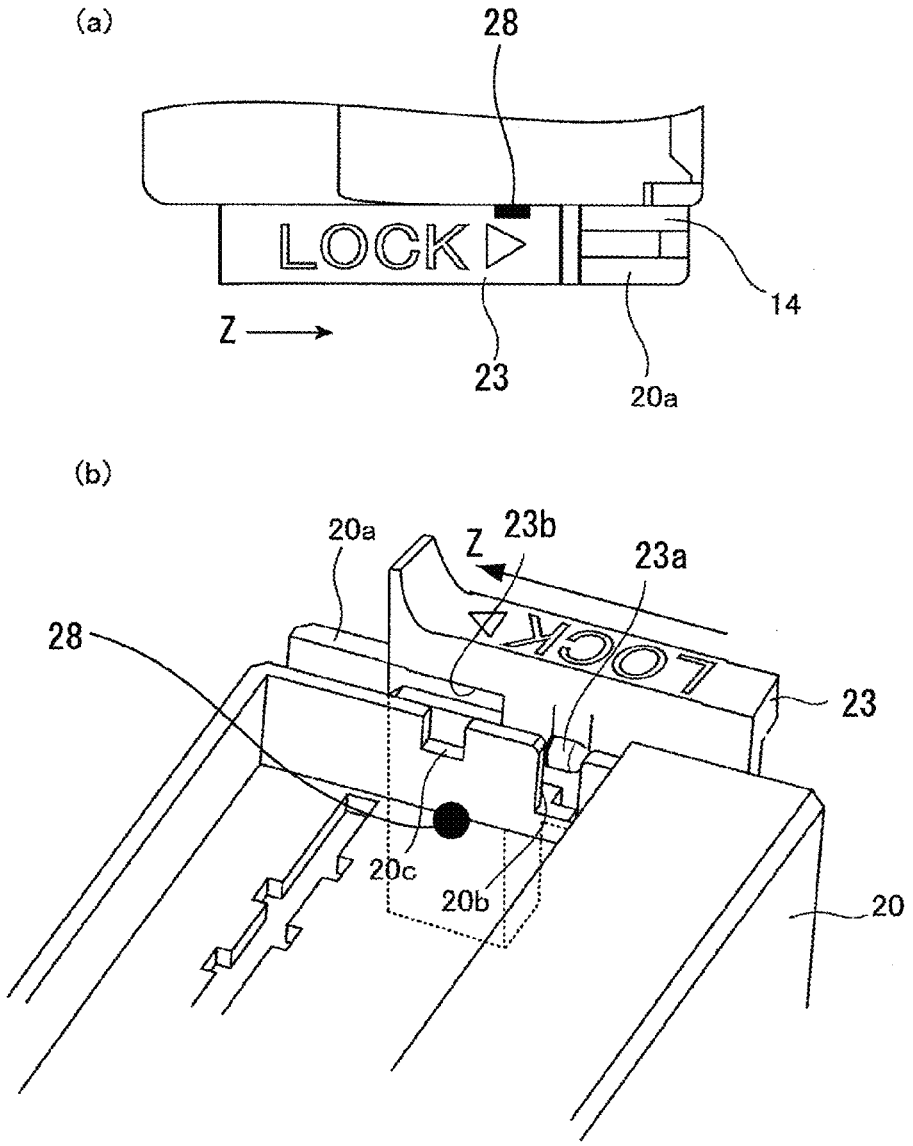


FIG. 6

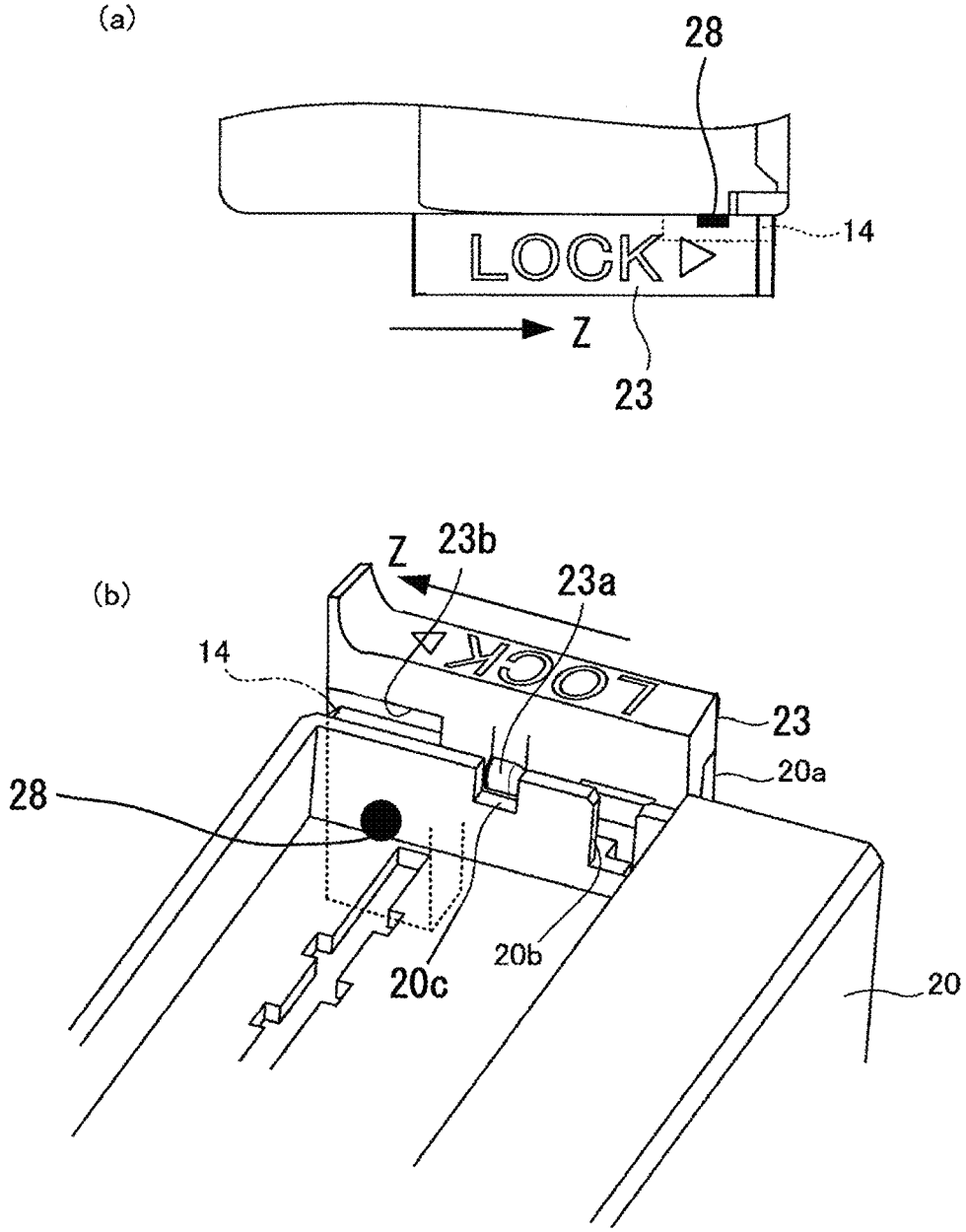


FIG. 7

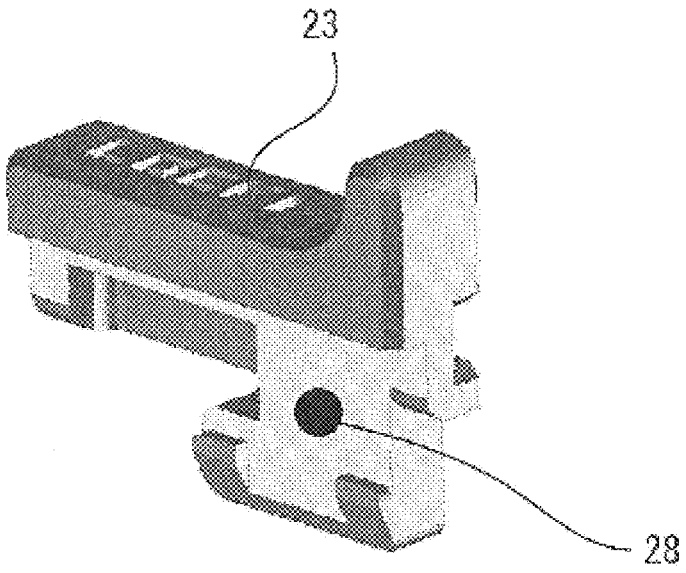
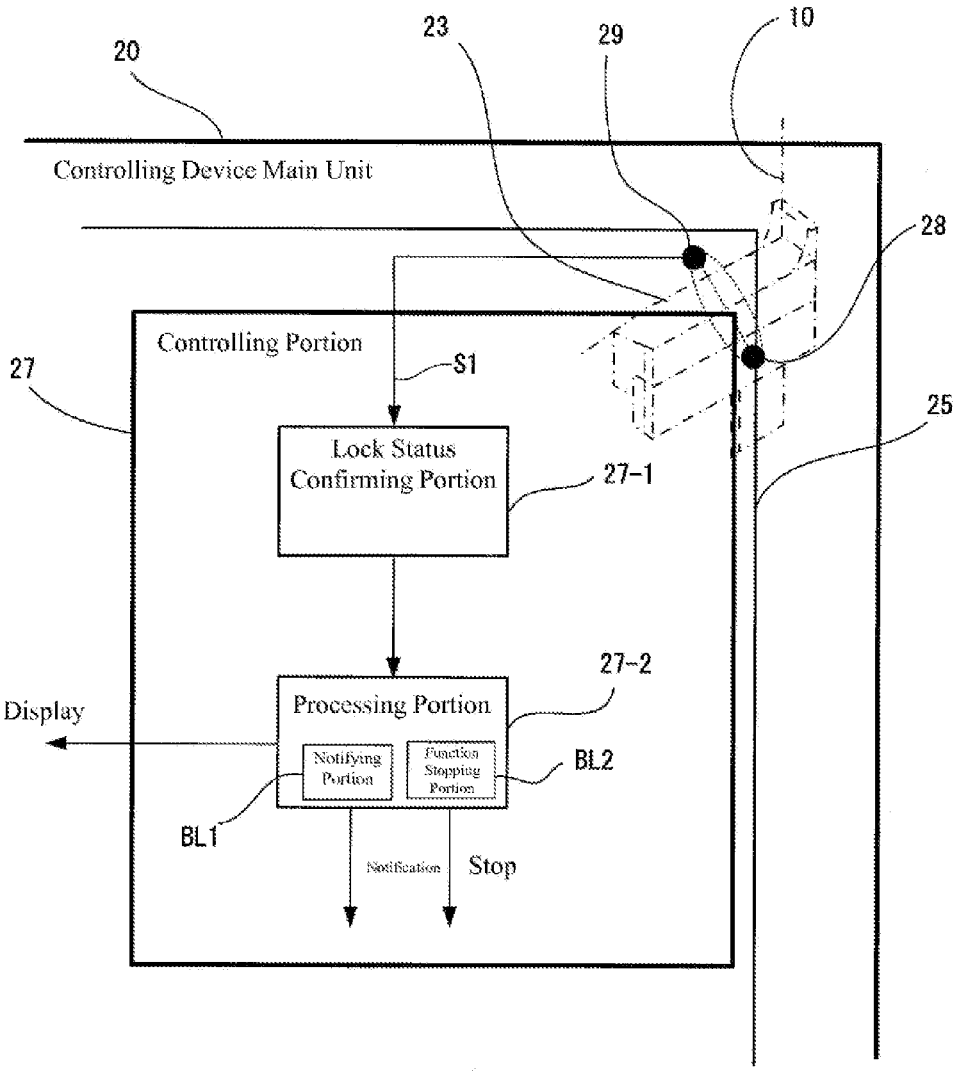


FIG. 8


20
23
29
10
Controlling Device Main Unit
28
Controlling Portion
27
S1
25
Lock Status Confirming Portion
27-1
27-2
Display
Processing Portion
Notifying Portion
Function Stopping Portion
BL2
BL1
Notification
Stop

CONTROLLING DEVICE

CROSS REFERENCE TO RELATED APPLICATION

The present application claims priority under 35 U.S.C. §119 to Japanese Patent Application No. 2012-164401, filed Jul. 25, 2012, the entire content of which being hereby incorporated herein by reference.

FIELD OF TECHNOLOGY

The present invention relates to a controlling device comprising a lock mechanism that locks, by moving a slide member, a terminal block that is attached to a controlling device main unit.

BACKGROUND

Controlling devices, such as temperature adjusting instruments, communication devices, display devices, driving devices, input/output devices, and power supply devices, are equipped with terminal blocks for inputting power and signals from sensors, or the like, and for outputting signals to the devices that are controlled. In recent years, structures wherein the terminal blocks can be removed from the controlling device main units have been used in order to enhance convenience in operations at the time of maintenance operations, and to accommodate miniaturization of the equipment.

For example, Japanese Unexamined Patent Application Publications 2002-203616 and 2010-146958 ("the JP '616" and "the JP '958", respectively) disclose controlling devices that use such structures. The controlling devices shown in the JP '616 and the JP '958 are provided lock mechanisms that lock, by moving a slide member, terminal blocks that are attached to a controlling device main unit. That is, the terminal block that is attached to the controlling device main unit is locked or unlocked through the movement of a slide member.

However, in a controlling device provided with the lock mechanism described above, if one forgets to lock the terminal block, then there will be the risk that the terminal block will fall out due to vibration or physical shock. Moreover, if the slide member were to move for some reason, then the terminal block would become unlocked, with the risk that the terminal block would fall out due to vibration or physical shock.

The present invention was created in order to solve the problem as set forth above, and an aspect thereof is to provide a controlling device able to detect if a terminal block is in a locked or unlocked state, and able to provide notification.

SUMMARY

A controlling device is provided with a controlling device main unit, a terminal block that is attached removably to the controlling device main unit, and a lock mechanism. The terminal block that is attached to the controlling device main unit is locked through the movement of a slide member. The slide member includes a permanent magnet disposed in a specific position. The controlling device main unit includes a magnetism detecting portion that detects magnetism of the permanent magnet, located in a location in proximity to the permanent magnet, disposed in the slide member, in a state wherein terminal block is locked through movement of the slide member, and a lock status confirming portion that confirms whether or not the terminal block is in a locked state, based on a detection signal from the magnetism detecting portion indicating whether or not magnetism is present.

Given this, when the terminal block is locked through movement of the slide member, the permanent magnet that is installed in the slide member approaches a magnetism detecting portion that is provided in the controlling device main unit. Through this, a signal indicating that magnetism of the permanent magnet has been detected is sent from the magnetism detecting portion to a lock status confirming portion, and the fact that the terminal block is in the locked state is confirmed.

In the present invention, in the lock status confirming portion, a check as to whether or not the terminal block is in a locked state is performed based on a detection signal from the magnetism detecting portion indicating whether or not magnetism is present. If, for example, the confirmation result of the lock status confirming portion is sent to a displaying portion, then it will be possible to discern, in the displaying portion, whether or not the terminal block is in a locked state. Moreover, a notification of the confirmation result by the lock status confirming portion may be sent, through communication, to an external device. Moreover, if it is confirmed, through the confirmation result by the lock status confirming portion, that the terminal block is not in a locked state, then functions for various types of signal processing between the controlling device main unit and the terminal block may be stopped.

Given the present invention, a permanent magnet is disposed in a specific location of the slide member, and the controlling device main unit is provided with a magnetism detecting portion for detecting magnetism of the permanent magnet in a location that is located near the permanent magnet that is provided within the slide member, when the terminal block is in a locked state through the movement of the slide member, and provided with a lock status confirming portion for confirming, based on a detection signal from the magnetism detecting portion indicating whether or not magnetism is present, whether or not the terminal block is in a locked state, and thus states wherein the terminal block is unlocked for locked can be detected, and notification thereof may be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an assembly perspective diagram illustrating the structure of an example of a controlling device according to the present invention.

FIG. **2** is a side view diagram of the controlling device and a cross-sectional diagram illustrating schematically the structure of the internal portion thereof.

FIG. **3** is an explanatory diagram illustrating the procedure for attaching the terminal block to the controlling device main unit in the controlling device.

FIG. **4** is a diagram when the controlling device in a provisionally secured state is viewed from the direction of arrow B in FIG. **1**.

FIG. **5** is a diagram illustrating the state wherein the slide member is released in the controlling device.

FIG. **6** is a diagram illustrating the state wherein the slide member is secured in the controlling device.

FIG. **7** is a perspective diagram illustrating the installation location of the permanent magnet in the slide in the controlling device.

FIG. **8** is a functional block diagram of the controlling portion in the controlling device.

DETAILED DESCRIPTION

An example according to the present invention will be explained below in detail, based on the drawings. FIG. **1** is an

assembly perspective diagram illustrating the structure of an example of a controlling device according to the present invention.

In the present example, the controlling device **100** is structured from a terminal block **10**, having a plurality of terminal portions **11**, and a controlling device main unit **20**, having a terminal block attaching opening **21** for attaching the terminal block **10**.

The terminal block **10** is provided with a plurality of terminal portions **11**, and a terminal cover **12** for covering over the terminal portions **11**, where a first protruding portion **13** is provided in the vicinity of the bottom face on one end in the lengthwise direction, and a second protruding portion **14** and a third protruding portion **15** are provided in the vicinity of the bottom face on the other end in the lengthwise direction. The first, second, and third protrusions **13**, **14**, and **15** are key-shaped or tab-shaped.

The controlling device main unit **20**, on the inside of one lengthwise-direction end of the terminal block attaching opening **21**, is provided with a fitting indentation **22** into which the first protruding portion **13** can fit, and is provided with a securing member **20***a* on the side face on the other lengthwise-direction end of the terminal block attaching opening **21**. A slide member **23**, which moves sliding in the direction of the arrow Z on the securing member **20***a*, to lock the terminal block **10** that is attached to the controlling device main unit **20** is provided on the top face of the securing member **20***a*. The slide member **23** is made from a non-magnetic material, and a permanent magnet **28** is embedded toward the bottom of the tip end portion in the direction of sliding (referencing FIG. **5** and FIG. **6**). The installation location of the permanent magnet **28** in the slide member **23** is illustrated in FIG. **7**. The locking of the terminal block **10** by the slide member **23** will be described below.

Moreover, a displaying portion **24** is provided on the top face of the controlling device main unit **20**, and printed substrates **25** and **26** are contained on the inside of the controlling device main unit **20**. In the printed substrate **25**, a Hall IC **29**, for detecting magnetism of the permanent magnet **28**, is provided at a location that is located in proximity to the permanent magnet **28**, provided in the slide member **23**, when the terminal block **10** is in a locked state through the movement of the slide member **23**. The Hall IC **29** corresponds to the magnetism detecting portions in the present invention.

FIG. **2** is a side view of the controlling device **100** and a cross-sectional diagram illustrating the schematic structure of the interior thereof, where FIG. **2** (*a*) is a side view of the controlling device **100** when viewed from the A direction in FIG. **1**, and FIG. **2** (*b*) is a cross-sectional diagram along the section b-b in FIG. **2** (*a*). A controlling portion **27**, structured from a CPU, a microcontroller, or the like, is mounted on the printed substrate **25** that is contained within the controlling device main unit **20**.

Attaching the Terminal Block to the Controlling Device Main Unit

FIG. **3** is an explanatory diagram illustrating the procedure for attaching the terminal block **10** to the controlling device main unit **20**, shown for the cross-sectional diagram along the section a-a in FIG. **1**. The procedure for attaching the terminal block **10** to the controlling device main unit **20** is shown in the sequence from FIG. **3** (*a*) through (*c*).

First, as illustrated in FIG. **3** (*a*), the first protruding portion **13** that is provided on one lengthwise-direction end of the terminal block **10** is fitted into the fitting indentation **22** of the terminal block attaching opening **21**. Following this, as illustrated in FIG. **3** (*b*), the bottom side end portion of the terminal block **10** is pushed in the direction of the arrow X.

The slide member **23** is provided on the securing member **20***a* on the side face on the other lengthwise-direction end of the terminal block attaching opening **21**. The cross-sectional shape of this slide member **23** is essentially a block-U shape, and a locking portion **23***a* that protrudes toward the inside of the terminal block attaching opening **21** is formed on the end portion that has this block-U shape.

When the bottom side end portion of the terminal block **10** is pushed in the direction of the arrow X, the pressure causes the third protruding portion **15** of the terminal block **10** to push against the locking portion **23***a* of the slide member **23**, and when pushed further, the locking portion **23***a* flexes as shown by the dotted line in the expanded view in FIG. **3** (*b*), enabling the third protruding portion **15** to go past the locking portion **23***a*. Thereafter, the release of the flexing of the locking portion **23***a* causes the key-shaped (tab-shaped) protrusion of the third protruding portion **15** to interlock with a protruding part of the locking portion **23***a*, to provisionally secure the terminal block **10** to the controlling device main unit **20**.

The state wherein the terminal block **10** is provisionally secured to the controlling device main unit **20** is illustrated in FIG. **3** (*c*). When in this provisionally secured state, even if a force were to be applied to the terminal block **10** in the direction of the arrow Y, a catch portion **22***a* is formed between the fitting indentation **22** and the displaying portion **24**, that is, on the side face of the fitting indentation **22** in the direction of removal of the terminal block **10**, and thus the first protruding portion **13** would strike against the catch portion **22***a*, preventing the terminal block **10** from coming out in the direction of the arrow Y. Furthermore, because the key-shaped (tab-shaped) protrusion of the third protruding portion **15** interlocks with the protruding part of the locking portion **23***a*, the terminal block **10** is prevented even more reliably from coming out in the direction of the arrow Y.

Locking the Terminal Block by the Slide Member

FIG. **4** is a diagram viewing the controlling device **100**, in the provisionally secured state, from the direction of the arrow B in FIG. **1**. In the provisionally secured state, the slide member **23**, as illustrated in FIG. **4**, is positioned in the released state, enabling the second protruding portion **14** to be checked from above. When the slide member **23** that is in this released state is slid in the direction of the arrow Z in FIG. **1**, the terminal block **10** that is attached to the controlling device main unit **20** is locked.

FIG. **5** shows the released state of the slide member **23**, and FIG. **6** shows the secured state of the slide member **23**. FIG. **5** (*a*) and FIG. **6** (*a*) are diagrams showing the slide member **23** from above, and FIG. **5** (*b*) and FIG. **6** (*b*) are oblique views showing the securing member **20***a*, which includes the slide member **23**, from the inside of the controlling device main unit **20**.

A rectangular fitting groove portion **23***b*, into which the second protruding portion **14** can fit, is formed on the inside of the slide member **23**. Furthermore, a rectangular release position groove **28***b* and lock position groove **20***c*, into which the locking portion **23***a* can fit, are formed in the side face of the controlling device main unit **20** wherein the slide member **23** is provided.

In the released state illustrated in FIG. **5**, the locking portion **23***a* fits in the release position groove **20***b*, and the second protruding portion **14** is positioned to the outside of the slide member **23**. In this released state, when the slide member **23** slides in the Z direction, then, as illustrated in FIG. **6**, the second protruding portion **14** of the terminal block **10** and the fitting groove portion **23***b* of the slide member **23** fit together, and also the locking portion **23***a* of the slide member **23**,

which had been fitted in the release position groove **20***b*, moves in the direction of the Z arrow as it flexes, to fit into the lock position groove **20***c*, to lock the terminal block **10** that is attached to the controlling device main unit **20**.

Confirming the Locked State

In the state wherein the terminal block **10** is locked to the controlling device main unit **20**, the permanent magnet **28** that is provided on the slide member **23** is in proximity to the Hall IC chip **29** of the printed substrate **25** that is contained within the controlling device main unit **20**. As a result, a signal indicating that magnetism of permanent magnet **28** has been detected (the detection signal indicating whether or not there is magnetism) is outputted from the Hall IC **29**.

The detection signals from the Hall IC **29**, indicating whether or not there is magnetism, is sent to a controlling portion **27** that is mounted on the printed substrate **25**. Note that the Hall IC **29** sins, to a controlling portion **27**, a detection signal with a level of "1" if magnetism is detected, and send, to the controlling portion **27**, a detection signal with a level of "0" if magnetism is not detected.

FIG. **8** shows a functional block diagram of the controlling portion **27**. The controlling portion **27** is provided with a lock status confirming portion **27-1**, for inputting a detection signal **51**, indicating whether or not magnetism is present, sent from the Hall IC **29**, and for confirming, based on the detection signal **51**, whether or not terminal block **10** is in a locked state, and provided with a processing portion **27-2** for performing various types of processes upon receipt of the confirmation result from the lock status confirming portion **27-1**.

In the controlling portion **27**, the lock status confirming portion **27-1** evaluates that the terminal block **10** is in a locked state if the level of the detection signal **51** that is sent from the Hall IC **29** is "1", and if it is "0", determines that it is not in a locked state. In this case, the proximity of the permanent magnet **28** is detected so a detection signal **51** of the "1" level is sent from the Hall IC **29**, and thus the lock status confirming portion **27-1** determines that the terminal block **10** is in the locked state. That is, it is confirmed that the terminal block **10** is in the locked state.

The confirmation result by the lock status confirming portion **27-1** is sent to the processing portion **27-2**. The processing portion **27-2** not only sends the confirmation result from the lock status confirming portion **27-1** to the displaying portion **24** for display thereon, but also uses a communication function to send the confirmation result to a peripheral controlling device (external device), or the like, through a network or the Internet. Moreover, the processing portion **27-2**, depending on the confirmation result by the lock status confirming portion **27-1**, stops the function for various types of signal processing (communication, DI/DO, AI/AO) between the controlling portion **27** and the terminal block **10** if locked state of the terminal block **10** is not confirmed.

Note that in the processing portion **27-2**, notification to an external device, or the like, of the confirmation result from the lock status confirming portion **27-1** is performed through a notifying portion BL**1**, and the stopping of the function for the various types of signal processing between the confirming portion **27** and the terminal block **10** is performed through a function stopping portion BL**2**.

In this way, given the controlling device **100** according to the present example, a permanent magnet **28** is provided in the slide member **23** and a Hall IC **29** is provided on the printed substrate **25** within the controlling device main unit **20**, enabling detection of the status of the terminal block **10** as unlocked or locked, and enabling notification thereof.

Note that while in the example set forth above, the permanent magnet **28** was provided toward the bottom of the tip end portion of the slide member **23** in the slide direction, insofar as the permanent magnet **28** is provided in the slide member **23** there is no limitation to the location thereof being near the bottom of the tip end portion in the slide direction. Moreover, the Hall IC **29** that is provided facing the permanent magnet **28** is not limited to the position thereof being on the printed substrate **25** insofar as it is able to detect magnetism of the permanent magnet **28**.

Moreover, it is anticipated that this type of controlling device **100** will be installed in a hostile environment, and that dust and dirt will become adhered thereto. In the present invention, the pair of the permanent magnet **28** and the Hall IC **29** is used to confirm that the terminal block **10** is in the locked state, thus enabling checking of the lock status of the terminal block **10** without making contact, doing so with superior environmental durability that is affected little by the surrounding dust and dirt, thus enabling the function for confirming the lock status of the terminal block **10** to be maintained stably over an extended period of time.

Extended Examples

While the present invention has been explained above in reference to examples, the present invention is not limited to the examples set forth above. The structures and details in the present invention may be varied in a variety of ways, as can be understood by one skilled in the art, within the scope of technology in the present invention.

The invention claimed is:

1. A controlling device comprising:

a controlling device main unit;

a terminal block that is attached removably to the controlling device main unit; and

a lock mechanism wherein the terminal block that is attached to the controlling device main unit is locked through movement of a slide member, wherein

the slide member includes

a permanent magnet disposed in a specific position, and the controlling device main unit includes

a magnetism detecting portion that detects magnetism of the permanent magnet, located in a location in proximity to the permanent magnet, disposed in the slide member, in a state wherein terminal block is locked through the movement of the slide member, and

a lock status confirming portion that confirms whether or not the terminal block is in a locked state, based on a detection signal from the magnetism detecting portion indicating whether or not magnetism is present, wherein

the controlling device main unit includes a function stopping portion that stops a function for various types of signal processing with the terminal block in response to a confirmation result from the lock status confirming portion if a status wherein the terminal block is locked is not confirmed.

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